Articles

A Comparison of Three Methods for Estimating the Requirements for Medical Specialists: The Case of Otolaryngologists

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Objective. To compare three methods of computing the national requirements for otolaryngologists in 1994 and 2010.

Data Sources. Three large HMOs, a Delphi panel, the Bureau of Health Professions (BHPr), and published sources.

Study Design. Three established methods of computing requirements for otolaryngologists were compared: managed care, demand-utilization, and adjusted needs assessment. Under the managed care model, a published method based on reviewing staffing patterns in HMOs was modified to estimate the number of otolaryngologists. We obtained from BHPr estimates of work force projections from their demand model. To estimate the adjusted needs model, we convened a Delphi panel of otolaryngologists using the methodology developed by the Graduate Medical Education National Advisory Committee (GMENAC).

Data Collection/Extraction Methods. Not applicable.

Principal Findings. Wide variation in the estimated number of otolaryngologists required occurred across the three methods. Within each model it was possible to alter the requirements for otolaryngologists significantly by changing one or more of the key assumptions. The managed care model has a potential to obtain the most reliable estimates because it reflects actual staffing patterns in institutions that are attempting to use physicians efficiently.

Conclusions. Estimates of work force requirements can vary considerably if one or more assumptions are changed. In order for the managed care approach to be useful for actual decision making concerning the appropriate number of otolaryngologists required, additional research on the methodology used to extrapolate the results to the general population is necessary.

Key Words. Work force requirements, otolaryngologists, health professions education, physician supply

For several decades policymakers have debated whether the United States is training the appropriate number of physicians and the appropriate mix of generalists and specialists. Interest in this issue intensified when President Clinton proposed limiting the number of physicians who could receive post-graduate training and restricting the number of positions in each specialty that would receive federal funding (Health Security Act 1993). Other policy-making groups, such as the Council on Graduate Medical Education and the Physician Payment Review Commission, have also recommended limits on the number of first-year residents and increases in the proportion of physicians entering primary care residencies (Rivo, Jackson, and Clare 1993). In 1995, the Pew Foundation and the Institute of Medicine recommended reductions in the number of physicians to be trained based on work force requirement projections.

The Association of American Medical Colleges and the American Medical Association have promulgated a set of principles to guide further discussions and analyses on the appropriate size and specialty mix of the physician work force (*Association of American Medical Colleges* [*AAMC*] *News* 1994). While both organizations believe that a better balance between primary care and specialty care physicians is necessary, they also caution that changes in the size and/or specialty mix must be approached carefully and deliberately. Many specialty societies have developed models to estimate requirements for their own specialty.

Our review of the literature suggests that three basic methods have been proposed to estimate physician work force requirements (Feil, Welch, and Fisher 1993; Tarlov 1986). One method uses the utilization and/or staffing patterns of managed care organizations to estimate the number of physicians required (Mulhausen and McGee 1989; Weiner 1994a,b). A second method

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uses current utilization patterns and anticipated changes in demographic and insurance coverage as well as estimates of physician productivity to predict the demand for physician services (Health Personnel in the United States 1991). A third method attempts to estimate the requirements for physician services by using a modified Delphi technique that asks a group of physicians (and possibly other health professionals) to anticipate the incidence of disease in their specialty, to suggest the number of individuals with that disease who should see a physician in their specialty, and to estimate the time required to treat that patient (Battelle Memorial Institute 1980; Steinwachs, Weiner, Shapiro, et al. 1986).

In this article we compare the results obtained by all three methods as we compute the national requirements for otolaryngologists in 1994 and 2010. The estimates are then compared to the number of active otolaryngologists who are (will be) providing patient care during that year. After presenting the results, we discuss our impressions of the validity of each of the three methods and recommend that future projections of physician work force requirements be based on extrapolations of staffing patterns of managed care organizations. A consensus is needed, however, concerning the appropriate extrapolation methods since the work force projections based on managed care staffing patterns are highly sensitive to the extrapolation method that is employed. We believe that the lessons learned from conducting this study of otolaryngologists will be applicable to other specialties.

METHODS

MANAGED CARE

Weiner estimated the total number of physicians that would be required in the year 2000 by reviewing staffing patterns in managed care organizations and extrapolating those numbers to the nation (Weiner 1994a,b). We modified his methodology in order to estimate the number of otolaryngologists that would be required if staffing ratios of staff model HMOs were used to determine otolaryngology work force requirements. First, we identified the three largest staff model HMOs (Faulkner and Gray, Inc. 1993). We focused on staff model HMOs because it was possible to obtain estimates of the number of full-time equivalent (FTE) otolaryngologists employed by the staff model HMO whereas other types of managed care plans had difficulty providing the number of FTE otolaryngologists. We focused on the three largest HMOs because they had sufficient internal capacity on order to minimize out-of-plan

use, because they were more likely than other types of HMOs to have enrollment demographics that approximated the U.S. population, and because their staffing patterns were likely to be more stable than those in smaller and more recently established HMOs. A review of published statistics suggests that the three staff model HMOs that were selected had overall staffing patterns that were similar to staffing in other staff model HMOs (HMO Industry Profile 1993).

We contacted each HMO and asked them how many otolaryngologists were actively employed, the number of current enrollees, and the percentage of their enrollees who were insured by Medicaid. We then divided the total number of otolaryngologists by the number of enrollees to derive an otolaryngologist-to-enrollee ratio.

Weiner identified five adjustments necessary to take into account when extrapolating HMO staffing ratios to the general population. Adjustments are shown in Table 1. (1) Demographic adjustments are necessary since the elderly are less likely to enroll in an HMO (Group Health Association of America 1993). Staffing ratios for otolaryngologists would need to increase by 13.3 percent to account for an older national population. (2) HMOs are less likely to serve persons enrolled in Medicaid and most serve no uninsured persons. If Medicaid and uninsured individuals were enrolled in managed care plans at the national average, then the number of otolaryngologists would need to increase by 5.7 percent. (3) Persons enrolled in an HMO may receive services from providers outside of the plan. The number of otolaryngologists required was increased by 10 percent to adjust for out-of-plan use. (4) Physicians employed by staff model HMOs are less productive than physicians practicing in an IPA/network model or fee-for-service. An estimate of 15 percent lower productivity was applied. (5) All Americans are insured. Two population scenarios regarding the percentage of the U.S. population enrolled in various types of insurance plans are assumed. The least-change and most-change scenarios represent two levels of market penetration into the insured population by staff model HMOs, integrated networks, and fee-for-service.

For our basic model we incorporated all five adjustments, assumed that everyone would be insured, and used Weiner's least-change scenario to estimate the requirement for otolaryngologists for 1994 and the most-change scenario to estimate the requirement for 2010. We also performed sensitivity analyses eliminating the effect of each of the adjustment factors individually and in combination to determine the effect of changing the extrapolation method.

Table 1: Managed Care Adjustments to Extrapolate to General Population

1. Demographic
   a. Ambulatory rates 13.5% higher in elderly (Weiner 1994b)
   b. Hospital discharge rates 12.9% higher in elderly (Weiner 1994b)
   c. Otolaryngologists spend 65% of time on ambulatory care and 35% on hospital care (Physician Market Statistics 1993)
   d. [(13.5% × 65%) + (12.9% × 35%)] = 13.3%
2. Medicaid and Uninsured
   a. Percent Medicaid enrollment in the three HMOs averaged 3.5% compared to a national average of 10% (Weiner 1994b)
   b. HMOs report that Medicaid enrollees require 13% more ambulatory care and 52% more hospital care (HMO Industry Profile 1992 ed.)
   c. [(13% × 65%) + (52% × 35%)] = 26.6% more otolaryngologist time required
   d. [(10% − 3.5%) × 26.6] = 1.7% increase in national otolaryngology staffing required
   e. Uninsured population estimated at 15% (Weiner 1994b)
   f. [(15% × 26.6%) + 1.7%] = 5.7%
3. Out-of-Plan Use
   a. Average out-of-plan rate for HMO enrollees is 0.5 visits per year (Scitosvsky, Benham, and McCall 1981)
   b. National annual in-plan visit rate is 4.5 visits per year (HMO Industry Profile 1992 ed.)
   c. Approximately 90% of covered services are delivered by HMO providers [(4.5 − 0.5) / 4.5]
   d. Number of otolaryngologists required increased by 10%
4. Physician Productivity
   a. Employed physicians are approximately 83% as productive as self-employed physicians (Physician Market Statistics 1993)
   b. Conservative adjustment of 15% lower productivity applies

DEMAND UTILIZATION MODELS

The Bureau of Health Professions has developed a demand model based on the current utilization of physician services as well as projections of changes in demographics, insurance coverage, and physician productivity.

There are three major components of the BHPr model (Bureau of Health Professions [BHPr] 1993): (1) the demand component of the model uses current age-, gender-, and race-specific utilization rates to estimate the number of encounters by specialty; (2) insurance status further refines the population into three insurance groups, fee-for-service, managed care, and uninsured; and (3) physician productivity, calculated using published statistics, is projected forward starting with data on the minutes required to perform a given service and adjusting for any expected changes in patterns of healthcare

delivery. The total number of physician FTEs required is computed by dividing required total patient care minutes by the average number of minutes worked per physician by specialty. We obtained estimates of the work force projections for otolaryngology directly from the Bureau of Health Professions.

ADJUSTED NEEDS ASSESSMENT

The Graduate Medical Education National Advisory Committee (GMENAC) was established in 1976 to forecast physician supply and the need for physician services. GMENAC relied on a modified Delphi technique to develop work force estimates (Graduate Medical Education National Advisory Committee 1980); subsequent refinements have been made to the basic GMENAC methodology (Tarlov 1986). We reviewed the GMENAC methodology and obtained the instruments used and the final results of the otolaryngology Delphi panel. Based on this information, we prepared tables showing initial estimates of incidence of disease, procedures commonly performed by otolaryngologists, hours per procedure, associated visits (inpatient and outpatient) per procedure, and a profile of weekly workload. These tables were given to two otolaryngologists for review and revision to reflect current practice. The tables were then presented to a Delphi panel of otolaryngologists and discussed by members of the group until a consensus estimate was obtained. The Delphi panel was asked to estimate the following:

- incidence rates of specific conditions;
- percentage of persons with that specific condition who should see a physician;
- percentage of persons who should be seen by a physician who should see an otolaryngologist;
- percentage of office visits that are nonsurgical;
- average number of preoperative office visits per episode;
- rate of commonly performed procedures;
- percentage of procedures that should be performed by an otolaryngologist;
- door-to-door procedure time;
- associated inpatient and office visits per procedure; and
- productivity estimates–profile of weekly workload.

At the conclusion of the meeting, it was clear that the panel was especially uncomfortable with one component of their estimates–the estimates of incidence rates. They were unsure how often specific diagnoses and/or

procedures occurred in the population. Subsequent to the meeting we obtained data on the average annual number of office visits to otolaryngologists for the most common principal diagnoses (Woodwell 1992). Although these visit rates do not describe the incidence of disease, the principal diagnoses rendered by otolaryngologists were assumed to be an indicator of the potential need for otolaryngologists. The visit rates associated with each diagnosis were further calculated to a figure reflecting visits per 100,000 population. These rates were used in estimating current needs in 1994. For conditions where actual visit rates were unavailable, the panel's original estimates were used. To estimate needs for 2010, incidence rates were obtained by comparing the panel's estimates of incidence rates in 1994 to its estimates for 2010 and applying this ratio to the estimates where visit rates were available. For conditions where visit rates were unavailable, the panel's estimates were used. We computed work force projections based on the panel's estimates of incidence and estimates of need based on visit rates, with the understanding that the visit rates by diagnosis were limited to a population who have access to care and who receive office-based care.

SUPPLY

We contacted the Populations Projections Branch of the U.S. Bureau of Census. The population figures reflect resident population, cited in *Current Population Reports*, P25–1104. The figure for 1994 (260,676,000) is a July 1, 1994 estimate. The figure for 2010 (300,431,000) is a middle series projection. We also obtained the year-end 1992 number of actual otolaryngologists involved in direct patient care, excluding residents and fellows, published by the American Medical Association.

RESULTS

MANAGED CARE

Table 2 shows the information provided to us by the three largest staff model HMOs. The staffing information we obtained ranges from a ratio of 1:33,197 and 1:46,285 (excluding residents). For the basic model, we elected to use the ratio of 1:35,000 enrollees, which translates to 2.86 FTE otolaryngologists per 100,000 population. This is within the range of previous studies, which varied from 2.2 FTEs to 3.3 FTEs per 100,000 population (Mulhausen and McGee 1989; Weiner 1994a,b).

A series of adjustment factors were then applied to extrapolate these results to the overall U.S. population. Table 3 shows the baseline number

of FTE otolaryngologists per 100,000 enrollees, assuming that the entire U.S. population is insured under a staff model HMO and adjusting for demographic differences, proportion Medicaid/uninsured, and out-of-plan use (Table 1). Table 3 also shows how the FTE/100,000 otolaryngologists was adjusted for productivity by health plan type.

Table 4 shows the overall number of otolaryngologists required by various types of health plan for enrollment assumptions for 1994 and 2010. Adjustments for demographics, proportion Medicaid/uninsured, and out-of-plan use were already incorporated (Table 3). A total of 7,939 otolaryngologists were required for 1994 and 9,505 were required in 2010.

We then examined the sensitivity of these results to various assumptions regarding the extrapolation to the general population. If we eliminate all of the adjustment factors that increase the number of otolaryngologists and include only the factors that decrease the number of otolaryngologists, then the number of otolaryngologists required in 1994 is 6,334 and the number required in 2010 is 7,300. If the assumption is made that the actual ratio, here defined as a mean of 1:35,000, of otolaryngologists to enrollees used by the staff model HMO is appropriate for all delivery systems, and if adjustments for demographics, proportion Medicaid/uninsured, and out-of-plan use are appropriate (Table 3), then the number of otolaryngologists required in 1994 is 9,827 and the number required in 2010 is 11,326. By excluding or including

Table 2: Actual 1994 Staffing Ratios for Otolaryngologists Reported by the Three Largest Staff Model HMOs

HMO	*FTEs*	*Enrollees*	*Actual Ratio Otolaryngologist to Members*
A	6.46	299,000	1:46,285
B	10.95	363,509	1:33,197
C	83.00	2,780,000	1:33,494

Table 3: Number of Otolaryngologists Required per 100,000 Enrollees by Type of Health Plan

Baseline FTEs: 100,000	2.86
Staff Model (2.86 × 1.13 × 1.06 × 1.10)	3.77
Integrated Network (3.77 × 15% productivity)	3.20
Open FFS (Actual 1992 data, Physician Market Statistics 1993)	2.69
Managed FFS [2.69 − (5% × 2.69)] (Utilization decreases by 5%, Weiner 1992)	2.56
Nonmetropolitan Areas (assumed the same as integrated networks, Weiner 1994a,b)	3.20

Table 4: Number of Otolaryngologists Required by Type of Health Plan for 1994 and 2010

		1994		*2010*	
Health Plan Type	*FTEs/100,000*	*% U.S. Population Enrolled*	*Number of Otolaryngologists Needed*	*% U.S. Population Enrolled*	*Number of Otolaryngologists Needed*
Metropolitan Areas					
Staff model	3.77	10	983	15	1,699
Integrated network	3.20	30	2,502	40	3,845
Managed FFS	2.56	25	1,668	15	1,154
Open FFS	2.69	10	701	5	404
Nonmetropolitan Areas					
FFS	3.20	25	2,085	15	1,442
Integrated network	3.20	0	0	10	961
Overall Number of Otolaryngologists Required			7,939		9,505

certain adjustment factors or a combination of factors, it is possible to obtain estimates of the required number of otolaryngologists ranging from 6,334 to 9,827 in 1994, and 7,300 to 11,326 in 2010. If the ratio of otolaryngologists to population were allowed to vary, the variation in the required number would show even greater variation.

DEMAND MODEL

The demand model used by the Bureau of Health Professions provided a single estimate of work force requirements (including residents and fellows)–8,860 otolaryngologists in 1995 and 10,715 in 2010–although it is possible to obtain different estimates from the model by altering assumptions.

ADJUST NEEDS ASSESSMENT

Table 5 shows the number of otolaryngologists needed estimated by the Delphi panel. The modified needs methodology provides estimates that ranged from 6,611 to 14,064 in 1994 and from 7,200 to 14,523 in 2010.

Table 6 summarizes the estimates for 1994 from the three models and compares the estimates to the actual number of otolaryngologists in 1993. Table 7 summarizes the estimates for 2010.

DISCUSSION

The number of otolaryngologists required across the three methods varied widely. For two of the methods, there was wide variation depending on the

Table 5: Number of Otolaryngologists Required Under the Adjusted Needs Model

Year	*Using Delphi Panel's Estimate of Incidence*	*Using Actual Incidence*
1994	14,064	6,611
2010	14,523	7,200

Table 6: Comparison of Three Models of Estimates for Otolaryngologists, 1994 (Excluding Residents and Fellows)

	Low Estimate	*Best Estimate*	*High Estimate*
Model			
Managed care	6,334	7,939	9,827
Demand*	NA‡	8,860	NA
Adjusted needs	6,611	6,611	14,064
Otolaryngologists, Actual†	NA	7,006	NA

*Bureau of Health Professions–estimated direct patient care otolaryngologists required, including residents/fellows.

†American Medical Association 1993: direct patient care otolaryngologists, excluding residents/fellows for year end 1992.

‡Not available.

Table 7: Comparison of Three Models of Estimates for Otolaryngologists, 2010 (Excluding Residents and Fellows)

	Low Estimate	*Best Estimate*	*High Estimate*
Model			
Managed care	7,300	9,505	11,326
Demand*	NA‡	10,715	NA
Adjusted needs	6,611	7,200	14,064
Projected Supply†	NA	11,770	NA

*Bureau of Health Professions, year 2010, estimated direct patient care otolaryngologists required, including residents/fellows.

†Bureau of Health Professions estimated supply of otolaryngologists, including residents/fellows.

‡Not available.

assumptions that were incorporated. For 1994, the best estimates for two of the models indicated a shortage of otolaryngologists. However, by 2010, the best estimate for two of the models is that there will be a surplus of

otolaryngologists. In each of the models, however, it is possible to show a shortage or surplus of physicians by altering one or more key assumptions. This suggests that any conclusions about the shortage or surplus of otolaryngologists must be viewed critically.

Although each of the three models had strengths and weaknesses, we had the most confidence in the projections made by the managed care model. It was clear to everyone involved in the process that the results obtained from the modified needs method were unscientific and subject to considerable bias. Too many judgments were required and the otolaryngologists did not believe that anyone would have the information necessary to make informed judgments. They were particularly uncomfortable with estimating incidence rates. However, even if actual incidence rates had been available to determine current needs, the members of the Delphi panel expressed discomfort with this approach. Critiques of the original GMENAC study also suggest that the reliability of the process is questionable. Selection of the members of the expert panel could introduce bias. Schroeder (1994) concludes that Delphi panels are unable to anticipate advancements in technology, new drugs, and new diseases that may affect the demand for physicians. He also points out that the GMENAC process cannot take into account changes in the way healthcare is delivered and paid for, for example, the increased number of Americans enrolled in HMOs. Furthermore, several critics have pointed out that inherent within the use of expert panels are the potential biases in adjustments (Schroeder 1994; Reinhardt 1981).

The demand model projects further work force requirements based on current utilization patterns. Essentially, it assumes that we have an appropriate number of otolaryngologists today, and then it trends this number forward based on projected changes in demographics, insurance coverage, and other demand variables. Assumptions concerning improvements in physician productivity are also required. Two major criticisms of this approach are the fact that it carries the biases of today's healthcare system into the future and its inability to anticipate future trends (Schroeder 1994).

Compared to the alternatives, the managed care approach is the most appealing because it reflects the work force staffing ratios of managed care organizations that operate in the marketplace and that emphasize productivity. However, the managed care approach has three significant limitations. First, it assumes that the current staffing patterns of staff model HMOs is appropriate for the future, ignoring technological advances or any other changes in medical practice (Schwartz, Sloan, and Mendelson 1988). It should be recognized, however, that this problem is common to any projection methodology and

that none of the three models is able to project the future technological changes, the incidence of new diseases, or changes in the way healthcare is financed and delivered. Second is the selection of the staff model HMOs. Staffing patterns vary considerably across managed care organizations. This was seen in Table 2. Third is the extrapolation methodology used in the approach. In order for this method to provide reliable estimates, more attention to the extrapolation methodology is necessary. Weiner (1994a,b) has suggested five adjustments; additional research on all five assumptions is required.

Numerous studies have shown that age and gender are poor predictors of healthcare utilization and healthcare expenditures (Beebe 1992; Newhouse et al. 1993). Studies have also shown that HMOs benefit from favorable selection (Newhouse et al. 1989). For example, HMOs may adjust staffing patterns of specialists such as otolaryngologists to influence enrollment or disenrollment of expected high-cost individuals (Anderson et al. 1986). As a result, it is likely that the age and gender adjustments presented here underestimate the size of the adjustment that is required to project HMO staffing patterns to the overall U.S. population.

Numerous studies have suggested that Medicaid and uninsured populations are generally less healthy than the overall population (Franks et al. 1993). However, other studies have shown that they use fewer services than the general population (Hahn 1994). A related study suggests that access to physician services and medical services varies from specialty to specialty (Kilpatrick et al. 1991). Specialty-specific projections will be necessary to project work force requirements for Medicaid and uninsured populations.

A review of the literature on out-of-plan use by HMO members identified a study performed more than a decade ago (Scitovsky, Benham, and McCall 1981). More recent studies would provide greater confidence in the appropriateness of the out-of-plan adjustment factor. Second, it is important to have projections for each specialty since out-of-plan use probably varies by specialty.

A comparison of patient contacts made between staff model physicians and other physicians suggests that staff model physicians work 15 percent fewer hours. This comparison ignores, however, the fact that most IPA and FFS physicians spend considerable time on patient billing and utilization review activities that probably are less time consuming in staff model HMOs. In addition, staff model HMOs attempt to identify the appropriate balance of physicians, nurses, and allied health professionals. All of these factors need to be examined more thoroughly if work force projections are going to be used to control the number of residency positions.

CONCLUSION

President Clinton's Health Security Act would have given specialty societies the opportunity to recommend appropriate numbers of residency positions that would have been funded under health reform (Health Security Act 1993). Even without the legislation, information on ways to determine future requirements for physicians by specialty will be important for specialty societies and program directors deciding on the appropriate number of residency slots. Many specialty societies have undertaken requirement studies for their own specialty (BHPr 1995). Medical students are making decisions about what residency program to enter based in part on projections of future need for physicians by specialty.

Empirical results obtained by concerted efforts to estimate the appropriate number of otolaryngologists showed a wide range of estimates using three different techniques. Having worked with all three methods, we believe that the managed care approach has the possibility of obtaining the most reliable estimates because it reflects actual staffing patterns in institutions that are attempting to use physicians efficiently. However, for this approach to be useful for actual decision making, additional research is necessary concerning the methodology for extrapolating to the general population the results obtained from specific HMOs. While projections of the number of physicians that are necessary will never be a science, if an attempt is made to regulate the number of residency positions–or if specialty societies want to do work force planning–then basing the projections on the staffing patterns of staff model HMOs and refining the extrapolation methodology appears to be the best method currently available. It is unlikely, however, that precise estimates of the number of health professionals required can be obtained.

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